

Case Study No. 18 UV-Cured Coatings

Prestige

Neodesha, KS

Background

Prestige was founded in 1967 and produces all-wood, semi-custom cabinetry. Oak, maple, cherry, and hickory are the primary wood species and are finished with eight different stain colors. While some plywood veneers are used, there is no particleboard in any of Prestige's products. Prestige operates one shift, five days per week. There are 240 employees, including sales staff and drivers; 170 of these employees are hourly employees on the manufacturing line. The finishing line has 29 employees: 18 on the spray line, 6 on the flat line, 4 to clean the finishing room at night, and 1 maintenance employee specifically for the finishing operations. Prestige has an annual production of 117,000 units, but anticipates this number will rise in 1999. The change to UV-curable coatings began in 1992, as a result of Prestige's search for a higher-quality finish.

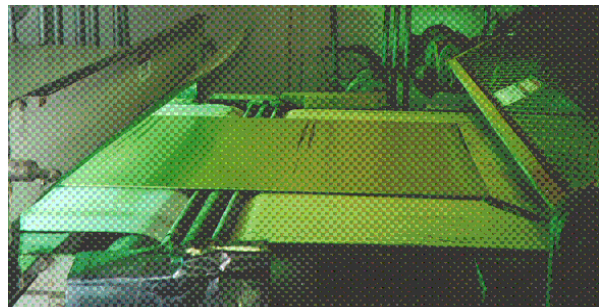
Manufacturing and Coating Operations

On average, it takes seven days to mill, finish, and assemble an order. Prestige receives raw lumber and planes it to size. The lumber is sanded, ripped, and cut to length. At this point, the pieces are sorted into four classes to provide a better color consistency in the final product. Three of the classes are purely color classes: light, medium, and dark. The other class is for a product that showcases the knots in the wood to create a more "rustic" appearance. As a result of utilizing the knotty material, Prestige has reduced their wood waste. After sorting, the pieces are glued together and cut to size. Cabinet components are finished prior to assembly.



Automated flat line

Prestige operates two automated finishing lines: a flat line and a spray line. There also are two small spray booths, one for touch-up and repair and one to apply coating to parts that cannot be finished on the automated lines. The pieces that cannot be finished by the automated lines make up a small percentage of production and include items such as shelf edges and Queen Anne legs. The coatings in both spray booths are solvent-borne and are applied using HVLP guns.

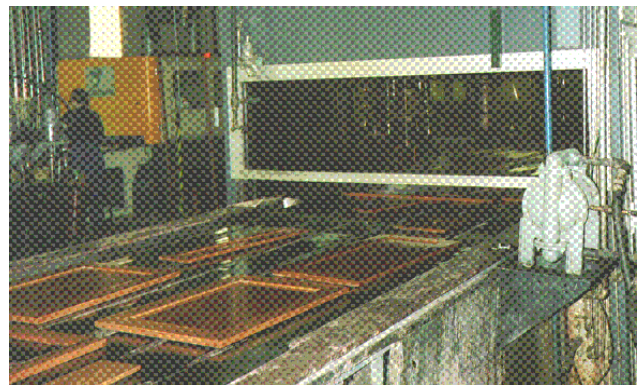


UV oven

The flat line is a horseshoe-shaped roll

coating line, used mainly for flat components such as cabinet box parts. The conveyor operates at 40 feet per minute. Pieces first go through a dual-sponge roll coater that applies solvent-borne stains or whitewash. One roll is used for all stains, but the white coatings require a separate roll because it is too difficult to clean the white coatings completely from the roll. A reclamation system is in place to catch all excess coating and funnel it back into the coating reservoir. The pieces then are conveyed through a series of three brushes that eliminate the hand wiping step. The stain then is sanded by an automated brush-sander and conveyed to a roll coater. These rollers are a combination of rubber and steel that apply the 100 percent solids UV-curable sealer. The line then moves under two UV lamps to cure the seal coat. A second coat of sealer is applied and cured, and the piece is brush-sanded. Two coats of UV-curable topcoat are applied; the first is cured using two UV lamps and the second is cured using four UV lamps. Pieces then pass through the line again to be finished on the opposite side.

The automated spray line is a circular line, with a cycle time of 15 minutes. The entire finishing process consists of three passes through the line and takes about 45 minutes. The spray line is used for pieces that are not entirely flat, such as doors, drawer fronts, face frames, and moldings. After the pieces are loaded onto the conveyor, they are hand sanded. A solvent-borne stain then is applied by the automated spray system. The system has electronic eyes that sense when product is passing through the booth, and spray coating only when product is present, which helps to reduce overspray. The spraying mechanism contains six chambers: two for stains, two for sealer/topcoat, and two that are empty. The coatings are directly pumped from 55-gallon drums located in the paint kitchen. There are four arms with two guns each that move in a circular pattern and are aligned to ensure coating is applied to the front or back and all four sides of a piece. All of the guns on the automated spray line are air-assisted airless, and have transfer efficiencies of 50 to 60 percent.



Automated spray line

After the stain is applied, the pieces go through a stain wiping machine and the edges are hand wiped. Components then are conveyed through a gas-fired oven to flash off the solvent in the stain and pass under three sets of UV lamps for curing. The pieces continue on the conveyor and pass through the second automated spray booth where the first coat of UV-curable sealer/topcoat is applied, then through a gas-fired oven where



Hand-wiping stain on component edges

coating solvent flashes off and under another set of three UV lamps for curing. The pieces then are sealer-sanded, turned over, and go around the line a second time for stain, sealer, and topcoat. The pieces go around the line for a third and final time, and UV sealer/topcoat is applied first to one side, then the other (no stain is applied on the third pass). The pieces then are taken off the finishing line and are ready for the assembly line.

Gluing Operations

Prestige previously was using a two-part formaldehyde glue that had to be mixed before application. In 1992, they began using all waterborne or hot melt adhesives. The quality of these glues is equivalent to the previous glue system, and the associated formaldehyde emissions have been eliminated.

Cleaning Operations

Neither of Prestige's finishing lines requires extensive cleaning. The flat line requires little cleaning; the brushes and sponge rollers are cleaned with a no-HAP cleaning solution. However, Prestige still uses acetone on the automated spray lines because an alternative cleaning solution has not been found that can do an adequate job. The automated spray line has four different dedicated coating lines fed into it, which reduces cleaning due to color changes.

Conversion to UV-Cured Coatings

Prestige previously had an overhead and cart line and was finishing with air-assisted airless and conventional spray guns. Their coatings were traditional solvent-borne stains, sealers, and topcoats. In 1992, while investigating higher-quality finishing systems, Prestige decided to switch to a waterborne UV-curable finishing system. From July 1992 to March of 1993, Prestige used a waterborne UV-curable sealer and topcoat on their automated spray line. The quality of the coatings they were using was poor, with an assortment of problems. The finish was very durable, but the appearance was not acceptable. Prestige had to replace thousands of dollars of product because of bad finishes. In March of 1993, Prestige switched to a solvent-borne UV-curable sealer and topcoat in the automated spray line. This system is still in use today.

Prestige was very disappointed with the waterborne UV-curable coatings. They had visited the supplier's lab to see the finish quality before installing the system, but never achieved results similar to what they had seen. Prestige is happy with the finish they are producing currently, using the solvent-borne UV-curable materials. The finish is durable and of comparable quality to their previous finishing system.

One of the main problems Prestige encountered with the solvent-borne UV-curable system was maintenance. The UV-curable coatings are very sticky and difficult to clean from the equipment, especially on the spray line. The only product that Prestige has found that does a good job is acetone. The flat line is easier to clean and Prestige has found a no-HAP cleaner that does a good job.

Another problem with the UV finishing system is repair. The UV-curable material cannot be spot repaired like the traditional solvent-borne coatings. When an entire piece needed to be refinished with the old system, the piece was placed in a wash-off tank filled with acetone to strip the damaged coating. However, the acetone does not strip off the UV-curable coatings; instead the entire piece must be sanded down to bare wood and refinished or entirely replaced. Other finishing problems include additional sanding and impurities in the coatings. Prestige does have filters in the lines to screen out the majority of impurities in the coatings, but occasionally receives batches that have enough impurities in them that the filter does not catch them all.

The operators did not have much trouble with the transition between coating systems. The systems are highly automated, but to achieve the finish Prestige requires, the spray line is operated with twice as many people as the equipment manufacturer suggested. The main reason for the extra labor is sanding. Because Prestige produces a true raised panel, an automated sander would only sand the raised center. For this reason, Prestige does all finish sanding on the automatic spray line by hand. However, prefinishing sanding can be done by a sanding machine and Prestige is in the process of implementing an orbital sander for prefinish sanding to reduce labor requirements.

Costs

The capital costs for the new finishing system were high, around \$1.2 million. However, that cost included a new building in which to house the finishing lines, so the actual capital cost to the UV-curing and finishing equipment was much less than \$1.2 million. An additional \$150,000 was spent for associated electrical equipment. The costs of operating the UV-curable coating line also are higher, as the coatings themselves are more expensive and the usage per cabinet is approximately the same. Prestige also replaced the conventional guns in their spray booth with HVLP guns at a cost of \$155 each.

Emissions

Prestige is a major source and is subject to the Wood Furniture NESHAP. The majority of the current emissions are from the stains and the spray booth that is used for touchup and repair. The emissions from the main finishing processes have been reduced significantly since the change to UV-curable coatings. Because of the changes in production, the best comparison is in pounds of VOC emissions per unit of product. With the old solvent-borne finishing materials, Prestige was emitting 2.7 pounds of VOCs per unit produced. After the change to UV-curable coatings, this number was reduced to 1.63 pounds of VOCs per unit produced, a 40 percent emissions reduction.